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# Impact of quasar proper motions on the alignment between the International Celestial Reference Frame and the Gaia reference frame

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## Abstract

© 2017 The Author(s). The International Celestial Reference Frame (ICRF) is currently realized by the very long baseline interferometry (VLBI) observations of extragalactic sources with the zero proper motion assumption, while Gaia will observe proper motions of these distant and faint objects to an accuracy of tens of microarcseconds per year. This paper investigates the difference between VLBI and Gaia quasar proper motions and it aims to understand the impact of quasar proper motions on the alignment of the ICRF and Gaia reference frame. We use the latest time series data of source coordinates from the International VLBI Service analysis centres operated at Goddard Space Flight Center (GSF2017) and Paris observatory (OPA2017), as well as the Gaia auxiliary quasar solution containing 2191 high-probability optical counterparts of the ICRF2 sources. The linear proper motions in right ascension and declination of VLBI sources are derived by least-squares fits while the proper motions for Gaia sources are simulated taking into account the acceleration of the Solar system barycentre and realistic uncertainties depending on the source brightness. The individual and global features of source proper motions in GSF2017 and OPA2017 VLBI data are found to be inconsistent, which may result from differences in VLBI observations, data reduction and analysis. A comparison of the VLBI and Gaia proper motions shows that the accuracies of the components of rotation and glide between the two systems are 2-4 μas yr-1 based on about 600 common sources. For the future alignment of the ICRF and Gaia reference frames at different wavelengths, the proper motions of quasars must necessarily be considered.

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## Keywords

Astrometry, Proper motions, Quasars: general, Reference systems

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